

A KEY TO NEOTROPICAL REGION FROG-EGG–FEEDING SPECIES OF *MEGASELIA* (DIPTERA: PHORIDAE), WITH A NEW SPECIES FROM PANAMA¹

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ABSTRACT. A new species of phorid fly, *Megaselia randi* sp. nov., is described from Panama. Adults of both sexes were reared from eggs of the frog *Agalychnis spurrelli* Boulenger. A key to the three species of phorid flies so far reared from neotropical frog eggs is given.

INTRODUCTION

The genus *Megaselia* Rondani is one of the largest genera in the Diptera, and perhaps one of the largest genera of living organisms (Bickel, 2009). The 1,500 species currently described in this genus are a small fraction of the true diversity, which may be ten times larger than this number. Single sites can have tremendous species richness, with the current record going to a site in Sweden where 330 species were identified (Bonet, 2006). No estimates are available for tropical sites, for which diversity is presumably much higher (as it is for many phorid genera).

Species of *Megaselia* have a wide variety of lifestyles (Disney, 1994), but are commonly thought of as generalized scavengers, probably because of the ubiquitous, polyphagous, often synanthropic species *Megaselia scalaris* (Loew) (Disney, 2008). It is difficult to imagine 300 or more species of generalized scavengers sharing the same lifestyle at one site, however, and as expected, research is continually uncovering examples of extremely specialized larval feeding in this genus (Ceryngier et al., 2006; Disney and Weinmann, 1998; Disney et al., 2001; Gonzalez et al., 2002).

In addition to opportunistic depredation by *M. scalaris* (Villa and Townsend, 1983), larvae of at least one other *Megaselia* species are known to attack frog eggs in the New World tropics (Downie et al., 1995; Neckel-Oliveira and Wachlevski, 2004). Herein we describe another species of *Megaselia* with this lifestyle.

METHODS AND MATERIALS

The study site, Barro Colorado Island (BCI), Panama, is a 1,500-ha island located in the center of the Panama Canal. The vegetation is characterized as a tropical moist forest with a canopy height of 35–40 m. Average rainfall is 2,600 mm a year, with a distinct dry season from December to April (Leigh, 1999). Kingfisher Pond, the breeding location of the frog *Agalychnis spurrelli* Boulenger (Hylidae), is located on the northwestern section of BCI and is a seasonally filled pond approximately 175 square meters in size. The pond typically fills during the early rainy season, in July, and dries by February.

Larvae were collected directly from infested frog eggs, and adults reared within test tubes under ambient outdoor conditions.

Specimens are deposited in the Natural History Museum of Los Angeles, CA, USA (LACM), Museo de Invertebrados Graham B. Fairchild, Universidad de Panama, Estafeta Universitaria, Panama (MIUP), and the Smithsonian Institution, Washington, DC, USA (USNM).

Megaselia randi new species (Figs. 1–6)

DESCRIPTION. Body length 1.5–1.7 mm. Frons brown, matte, frontal setae long (Fig. 1). Ventral interfrontal setae displaced laterally to eye margin. Ventral supra-antennal setae about one-half length and thickness of dorsal supra-antennal setae. Flagellomere 1 round, brown. Palpus yellow, with well-developed setae. Scutum and scutellum brown; anterior scutellar setae small, similar in size to scutal setulae. Pleuron brown, except venter of anepisternum, all of katepisternum and meron yellow. Anepisternum without setae. Legs yellowish, except anterior face of hind femur light yellowish-brown with brown spot apically. Hind femur with long ventral setae on basal one-half. Hind tibia with differentiated row of posterodorsal setae only. Mean wing length 1.54 mm, range 1.43–1.78 mm (Fig. 2); mean costal length 0.57 wing length, range 0.56–0.58. Mean costal sector ratio 3.15:2.91:1, range 2.67–4.00: 2.44–3.50:1. Wing vein R_{2+3} present. Halter brown.

Male abdomen. Tergites brown. Ventral membrane gray, with scattered setae. Epandrium brown, hypoproct and cercus yellowish brown. Left lobe of hypandrium with long, truncate process (Fig. 3).

Female abdomen. Dufour's mechanism broadly rounded, large (Fig. 4). All tergites present and well developed (Fig. 5), brown in color. Ventral membrane gray, with scattered setae. Tergite 7 quadrate, sternite 7 triangular (Fig. 6). Tergite and sternite 8 both pair of separate sclerites.

HOLOTYPE. ♂, PANAMA: Barro Colorado Island, Kingfisher Pond, 2.x.2009, R. Horan, reared from *Agalychnis spurrelli* eggs [LACM ENT 237515] (LACM).

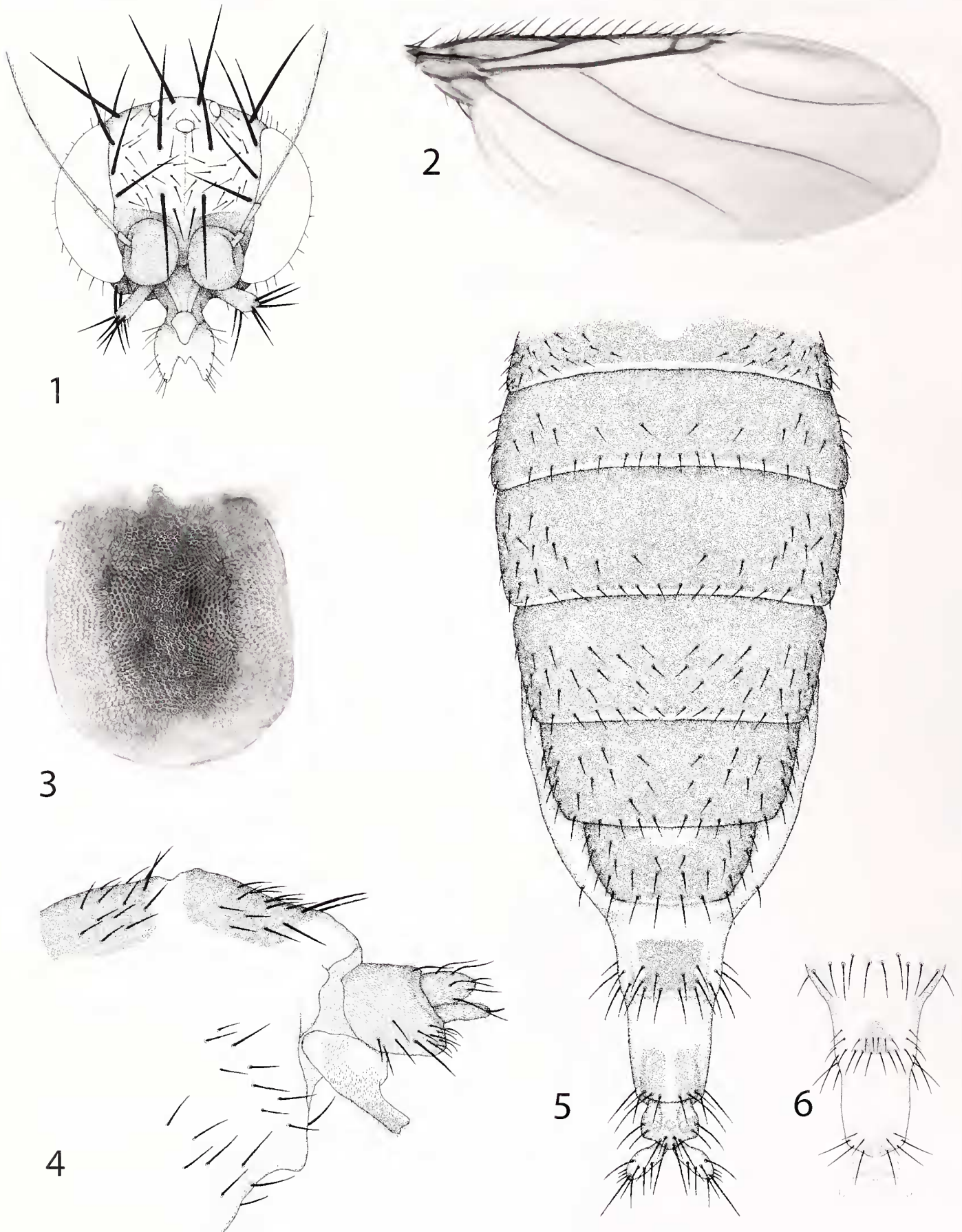
PARATYPES. 5♂, 11♀, same data as holotype (LACM, MIUP, USNM).

RECOGNITION. This species keys easily to the genus *Megaselia* in the latest key to world phorid genera (Disney, 1994). In traditional classifications of this genus, *M. randi* would be placed in subgenus *Megaselia*, because of the lack of setae on the anepisternum, and in “group VII” because of its relatively long costa and short anterior scutellar setae. Such groups have recently been abandoned, however, with the realization that they are not monophyletic assemblages.

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Figures 1-6 1. head; 2. wing; 3. Dufour's mechanism; 4. male abdomen: lateral; 5-6. female abdomen: 5, dorsal; 6, ventral apex.



Figures 7–10 7. adult female *Agalychnis spurrelli*; 8. phorid larvae on frog eggs; 9. healthy egg mass; 10. infected egg mass.

One of the difficulties presented by this genus is the scattered nature of its associated literature. In the latest keys to neotropical *Megaselia* (Borgmeier, 1962, 1969, 1971), *M. randi* does not key to any known species. In Borgmeier (1962),

it keys to couplet 45 of the Group VII key on page 309, but does not fit either option. The first lead in couplet 45 is (translated from German) “ventral interfrontal setae almost immediately under ventral fronto-orbital setae; costa 0.47 wing

length ... *M. zeno* n. sp. " and fits *M. randi* in the first character, but not in the second (the costal length is much longer in *M. randi*). Furthermore, the halter is yellow in *M. zeno*, but brown in *M. randi*, and *M. zeno* is found in southern Brazil. Keying is similarly unsuccessful in Borgmeier's other papers (1969, 1971). All of the 22 species described since Borgmeier's last work (Boesi et al. 2006; Disney, 1982, 1989, 1995; Disney and Berghoff, 2007; Disney and Rettenmeyer, 2007; Disney and Sakai, 2001; Disney and Sinclair, 2008; Disney and Weinmann, 1998; Downie et al., 1995; Gonzalez et al., 2002; Kung and Brown, 2004; Weinmann and Disney, 1997) also differ from ours.

The adults of the three known phorid flies reared from eggs of neotropical frogs can be identified using the following key:

- 1 Halter knob yellow; all abdominal tergites dark brown with yellow markings; male with extremely robust, feathered (with small microtrichia) seta at tip of proctiger clearly longer and thicker than setae on cercus; female with tergite 6 short, extremely broad, extending laterally on segment *Megaselia scalaris* (Loew)
- Halter knob brown; at least some tergites wholly brown; seta at tip of male proctiger subequal in size to those on cercus and not feathered; female with tergite 6 of normal size, smaller and narrower than tergite 5 2
- 2 Anepisternum bare; anterior scutellar setae much smaller than posterior pair; all female tergites large, only gradually reduced in size posteriorly; tergite 4 larger than tergite 5 *Megaselia randi* sp. nov.
- Anepisternum with small setae; anterior scutellar setae subequal to posterior pair; female tergite 4 greatly reduced, rounded, about one-half size of tergite 5 or less *Megaselia nidamurrae* Disney

NATURAL HISTORY OBSERVATIONS. First observations of egg clutches of *Agalychnis spurrelli*, the gliding leaf frog (Fig. 7), were made on August 11, 2009. Frogs sporadically laid clutches with no sign of fly infestation (Fig. 9) until mid-September, when maggot-infested clutches were observed (Figs. 8, 10). By October 2, 2009, the majority of clutches appeared to be infested with maggots. Larvae were collected on this date and reared in moist-cotton-filled test tubes capped with aluminum foil and held at ambient temperature in an outdoor field lab. Maggots appeared to become dormant soon after being placed within the tubes. Adult flies emerged on October 18, when most were discovered already dead in the tubes and preserved in ethanol immediately. All clutches infested with larvae were considered completely failed. It is not known whether the eggs were infertile, damaged by another organism and scavenged by the flies, or directly preyed upon by the flies.

DERIVATION OF SPECIFIC EPITHET. We name this species in honor of herpetologist Stan Rand, who was a key influence on R.V.H.'s work.

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